and if he only received eleven replies it cannot be denied that the writers of these replies fairly represented all sorts and conditions of men, and that the subject has been discussed, (1) in its academic aspect, (2) from the point of view of the experienced schoolmaster, and (3) from the standpoint of the engineer. The book contains a reprint of the recommendations of the Committee of the Mathematical Association on the Teaching of Elementary Mechanics.

What conclusions can the average reader infer from the divergent opinions expressed in this book?

(1) There is a general consensus of opinion that the teaching of mechanics should be more experimental and less dogmatic.

(2) Prof. Perry condemns the use of costly and complicated laboratory apparatus, and considers that more can be learnt from a cheap screw jack and a rusty old pulley than from costly Atwood's machines. In this he is perfectly right.

(3) If the teaching of mechanics is to be made more practical, greater attention should be paid to friction and other resistances which occur in nature. So long as friction is shelved into the background, mechanics cannot be anything but the study of what would happen under impossible conditions.

(4) The advocates of the poundal and the advocates of the slug will never agree.

(5) The academic side does not wish the poundal adopted for practical purposes (p. 13). In examination papers answers are never—well hardly ever—asked for in poundals, and generally a candidate would lose marks by giving the pull of a railway engine in poundals or tonals. But the academic teacher strongly objects to swallowing the slug, and not without reason.

(6) The engineering side is trying hard to force the slug down the throat of the academic teacher, its main plan of campaign consisting in attacking the poundal as unit of force.

(7) Both sides seem willing, up to a certain point, to allow beginners to solve elementary problems by the use of Newton's laws, according to which change of motion is proportional—not equal to the impressed force—a method which avoids both the poundal and the slug. But they still cling tenaciously to the modern substitute for Newton's statements.

(8) The engineering side has had to accept the C.G.S. dynamical units, and there seems no reason why schoolboys should not leave the equation $F=ma$ until they learn to work with the metric system.

(9) The universal adoption of the metric system affords the most probable direction for a compromise.

(10) Prof. Perry advocates (p. 61) teaching mechanics through force rather than through mass as the fundamental notion; and yet some remarks seem rather to indicate that he wishes *every schoolboy* to realise that force is the vector time flux of momentum.

(11) Many teachers condemn tonals, velos and celos, others strongly advocate them. One critic (p. 55) goes so far as to express regret "that for units of momentum and mass-acceleration we have no suitable names at all"; but does not the *poundal* meet his requirements when regarded as the unit of *mass-acceleration?* Surely it is the use of this unit for measuring *forces* (by naval engineers and others) that is open to the serious objections raised on p. 64.

(12) The same differences exist in regard to centrifugal force.

We have no wish to reopen controversies on these questions, but we cannot help thinking that if every schoolboy is to know the laws of motion, it is also important that every schoolboy should know a great deal about the laws of the country he lives in. He should also learn something about economics, something about choice and chance, in order that he may not develop into a gambler, some experimental and geometrical optics, and many other things besides, which he does not now learn. That "it must be good for all boys to learn something of measurement and how to use their hands" is a point on which all can agree with Prof. Perry. G. H. B.

OUR BOOK SHELF.

What Are We? By Leonard Joseph. Pp. xiii+394. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1906.) Price 15*s*. net.

"THEY say the owl was a baker's daughter. Lord, we know what we are, but know not what we may be." A certain incoherence in Ophelia's words would have prevented us at one time from regarding her as a possible authority on the metaphysical questions raised by the title to this book, but she is soundness, suggestiveness, and lucidity themselves when compared with Mr. Joseph.

Three peculiarities in this pretentious work will strike the observant reader:—(1) Excellent as "Chambers's Encyclopædia" and the paper called *Answers* are in their own place—and Prof. York Powell is said to have thought highly of the latter—we doubt if there are many scientific works of the first rank in this country in which these are paraded in the foot-notes or in the list of books consulted. (2) Mr. Joseph poses in the opening paragraphs as an orthodox believer whose motto is "Search the Scriptures, watch and pray," but confesses in the end, with much pride, that this is merely a device to secure for his pages a reading from unreasonable and stubborn church-goers. It would have been more tactful to assume that all his readers were reasonable human beings, or that, at any rate, the weight of the arguments adduced would of itself overcome all initial distrust. (3) Mr. Joseph argues soberly—if the term sober can be applied without contempt to one who apparently abhors total abstainers as amongst the most depraved of men—for sexual promiscuity. This is bad; indeed, it is even worse than the unsound physiology that defaces the last page, or than the wealth of padding which surrounds and encompasses what might have received adequate treatment in a sixpenny pamphlet.

The Human Mechanism, its Physiology and Hygiene and the Sanitation of its Surroundings. By Prof. Theodore Hough and Prof. W. T. Sedgwick. Pp. ix+564. (Boston and London: Ginn and Co., 1906.) Price 8*s*. 6*d*.

MANY writers of text-books on physiology for the lay public are quite incompetent to act as teachers of their fellow men, because they are unacquainted with the

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science they profess to write about, or imagine that a description of the bones and a few other anatomical facts constitutes physiology so far as the general public are concerned. There are, of course, some books which are notable exceptions to this rule, but we never remember to have seen one before which so admirably fits the purpose for which it is written as the little treatise before us, which the authors have labelled "The Human Mechanism."

A little anatomy has, of course, to be introduced, but this is kept in the background; what comes to the front is the study of function; this is well up to date, and the first half of the book is a clear and succinct account of modern physiological knowledge. It avoids unnecessary details, but omits nothing essential. It is so lucidly written that the wayfaring man will have to be a terrible fool if he does not understand it.

From such a sure bed rock, the authors pass on in the second part of the book to the application of physiological laws, and treat of personal, domestic, and public hygiene in turn. We can award to this part no higher praise than to say that it is as excellent as the preliminary physiological portion. It teems with sound practical common sense; it points out convincingly, avoiding too great technicality, the scientific reason for their faith. If the people at large and their rulers could be induced to act on its precepts, preventive medicine would indeed make a great stride in the battle man is always waging against disease and the consequences of his misdeeds.

Arithmétique graphique. Introduction à l'Étude des Fonctions arithmétiques. By G. Arnoux. Pp. xx+226. (Paris: Gauthier-Villars, 1906.) Price 7.50 francs.

ASSISTED by M. Laisant, the author has put into an interesting and occasionally novel form the elementary theory of congruences, indices, and residues of powers. He has also given various examples of the use of Galois's imaginary units, and of the solution of cubic congruences by means of Cardan's formula. There is nothing essentially new in the book, but it is entertaining as the work of an amateur who has looked at the subject in an independent way, and has occasionally put the facts into an unusually vivid form, for instance when he gives a chess-board diagram showing the solutions of $x^2+y^2 ||| 2$ (mod 5), and so on.

Familiar Trees. By Prof. G. S. Boulger. Pp. vi+160. (London: Cassell and Company, Ltd., n.d.) Price 6*s*.

As the author informs us in his preface, the book is an endeavour to describe the beauties of our familiar trees. He further points out that "Their many associations have interests that appeal to the historian and the moralist, to the student of literature and of folk-lore, but little less than to those interested in botany." . . . "The time has gone by when we could be content to stand agape at the wonders and beauties of the world of Nature; we require now some attempt, at least, at an analysis of the origin, purpose and significance of the objects of our admiration." Mr. Boulger has certainly given a fairly interesting account of a few of the commoner trees and shrubs. In his introduction he defines trees as perennial plants with a principal stem of some considerable diameter, rising from the ground and forming wood. Their woodiness distinguishes them from all herbs, and their one principal stem from shrubs. In spite of this, however, he includes in his book of familiar trees shrubs and even climbers, while such familiar trees as the oak, beech, and the lime are omitted and the Scots pine dismissed with a passing reference.

The author has, however, brought together a considerable amount of interesting material concerning the species with which he deals, and the value of the book is greatly enhanced by the many beautiful coloured plates and photographs. The appearance of the cross-section of the wood of the various species is well illustrated by selections from Mr. J. A. Weale's unique collection, and these, like the other plates and figures, do great credit to the artists by whom they were produced.

LETTERS TO THE EDITOR.

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Radium and Geology.

AFTER reading Arrhenius's vivid account[1] of the bombardment of the earth by electrically charged solar dust, one is prepared to appreciate Prof. Joly's hypothesis as set forth in his letter in NATURE of January 24. On the other hand, Mr. Strutt's analysis of granite affords strong support to the view that the radium it contains is of terrestrial origin. The concentration of this constituent in the biotite might conceivably be due to the absorption of percolating water containing radium in solution, but not in the zircon, a mineral which is as impermeable as quartz. A mineral analysis of Cornish granite from Penrhyn, made by Miss Davies in our geological laboratory, gave the following results:—orthoclase, 24·62 per cent.; albite, 13·42 per cent.; quartz, 40·23 per cent.; muscovite, 10·05 per cent.; biotite, 11·46 per cent.; magnetite and zircon, 0·16 per cent. The heavy portion of the Cornish granite analysed by Mr. Strutt, which was insoluble in hydrochloric acid, consisted of silica hydrate and zircon, and if the latter mineral was present to the extent of 0·16 per cent. only, it must have contained, judging from the analysis, $0{\cdot}637 \times 10^{-12}$ gram of radium per gram, or a little less than was found in crystals of zircon from North Carolina. In the consolidation of granite, the zircon crystallises out first, then the biotite, next the muscovite, afterwards the albite, and, finally, the orthoclase and quartz; but the concentration of radium diminishes in a similar order, a correspondence that can hardly be the effect of chance.

In the formation of granite, water has undoubtedly played a large part, and may have had a good deal to do with its differentiation from the parent magma. Water forms one of the constituents of biotite, sometimes to the extent of 10 per cent. Thus it is possible that the richness of granite in radium is due to the removal of this constituent in solution from the general mass of a magma and its concentration in certain portions which were converted by hydration into granite.

But if this be true of granite, may it not be true as well of basalt and other basic rocks in which also water plays its part, though to a less extent? All the igneous rocks to which we have access are very superficial parts of the earth's crust, and it is unsafe to reason from them to the deeper underlying regions. There may be other causes, apart from solution, by which electrically charged atoms like those of disintegrating radium have found their way up from below to enrich the outermost layers of our planet. In any case, the assumption that radium is uniformly distributed through a crust forty-seven miles in thickness seems to require support from independent evidence, and until that is forthcoming it is equally open to us to assume a thick crust, 800 miles, consisting of silicates, with radium distributed through it according to some unknown law, but with a rapid increase towards the zone affected by highly heated waters.

January 26. W. J. SOLLAS.

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[1] Arrhenius, "Lehrbuch der kosmischen Physik, 1903," p. 149. (Leipzig.)

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